

What is claimed is:

1. A system for performing sputter etching, comprising:

(a) an ion source that generates an ion current directed at a substrate;

(b) an electron source that generates an electron current directed at the substrate;

5 (c) biasing circuitry that biases the substrate with an a-symmetric bi-polar DC voltage pulse signal, the circuitry being formed from a positive voltage source with respect to ground, a negative voltage source with respect to ground and a high frequency switch;

(d) at least one current sensor, coupled to the biasing circuitry, that monitors a positive current and a negative current from the substrate during one or more cycles of the a-symmetric bi-polar DC voltage pulse signal;

10 (e) a controller, coupled to the at least one current sensor, that varies the ion current independently from the electron current;

(f) wherein the ion and electron sources create a continuous plasma proximate the substrate, and the biasing circuitry causes the substrate to alternatively attract ions and electrons from the plasma;

15 (g) wherein the ions attracted from the plasma sputter etch the substrate; and

(h) wherein the electrons attracted from the plasma neutralize accumulated charge on the substrate.

20 2. The system of claim 1, wherein the ion source, the electron source and the substrate are disposed in a chamber having a pressure between 10^{-3} to 10^{-5} torr during operation of the system.

3. The system of claim 1, wherein the controller varies the a-symmetric bi-polar DC voltage pulse signal used to bias the substrate independently from the ion and electron currents.

4. A method for performing sputter etching, comprising:

- (a) generating an ion current directed at a substrate by an ion source;
- (b) generating an electron current directed at the substrate by an electron source;
- (c) biasing the substrate with biasing circuitry that generates an a-symmetric bi-polar

5 DC voltage pulse signal, the circuitry being formed from a low voltage source, a high voltage source and a high frequency switch;

(d) monitoring, with at least one current sensor coupled to the biasing circuitry, a positive current and a negative current from the substrate during one or more cycles of the a-symmetric bi-polar DC voltage pulse signal;

10 (e) varying, with a controller coupled to the at least one current sensor, the ion current independently from the electron current;

(f) wherein the ion and electron sources create a continuous plasma proximate the substrate, and the biasing circuitry causes the substrate to alternatively attract ions and electrons from the plasma;

15 (g) wherein the ions attracted from the plasma sputter etch the substrate; and

(h) wherein the electrons attracted from the plasma neutralize accumulated charge on the substrate.

5. The method of claim 4, further comprising:

20 adjusting an ion kinetic energy E of the ion current produced by the ion source to between 20 eV and 200 eV;

tilting a surface plane of the substrate such that energetic ions produced by the ion source approach the surface plane of the substrate at an angle θ between normal incidence and grazing incidence;

adjusting an amplitude of negative voltage pulses applied to the substrate to a desired
5 value of V_{neg} ;

wherein ions striking the substrate have an angle of incidence α which is represented by a vector sum of a velocity imparted by acceleration of the ion source and a velocity imparted by the negative voltage pulse amplitude applied to the substrate; and

wherein ions striking the substrate remove material from the substrate due to sputtering at
10 the angle α .